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NOTE: THIS COPY WITH 1 ATTACHMENT, TAB E, ONLY. (TABS A, B, C, D NOT INCLUDED.)

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STATUS

OF

METEOROLOGICAL SUPPORT PROGRAM

FOR

HYPERSONIC AIRCRAFT AND RECONNAISSANCE SATELLITES

PREPARED BY:

HEADQUARTERS AIR WEATHER SERVICE

BRIGADIER GENERAL N. L. PETERSON, COMMANDING

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1. Purpose.

To outline the status of the Air Weather Service support program for manned hypersonic aircraft operating at an altitude o[redacted] feet and reconnaissance satellites. 25X1

2. Introduction.

Meteorological support to hypersonic aircraft has been treated in a series of papers previously submitted. These are included in Tabs A through D. In view of the current interest, this paper will be expanded to include military reconnaissance satellites. The fundamental support programs applicable to both systems will be treated, followed by a treatment of specific programs for each system.

3. Fundamental Requirement and Programs.

a. Data Requirements.

A detailed treatment of data requirements, and, Air Weather Service capability for collection of these data at the time the problem of support to hypersonic aircraft was posed in September 1959, will be found in Tab A. The primary requirement is for: (1) temperature, (2) pressure, (3) wind speed and direction, (4) moisture, and (5) cloud type, amount, and distribution. These data are required from the surface to 100,000 feet over the northern hemisphere (with particular emphasis north of 40 degrees north latitude). Other atmospheric properties,

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[redacted] 25X1

or conditions, of interest are: (1) turbulence, (2) wind shear, (3) radiation, (4) ozone, (5) icing, and (6) shock waves. The degree to which these may be important should be determined during the test and evaluation phase.

b. Status of Data Collection Facilities.

(1) Joint USWB - USAF Arctic Program.

(a) Progress.

A joint agreement has been negotiated with the U. S. Weather Bureau to improve the radiosonde facilities at seven selected stations in the Arctic; namely, Ft. Churchill, Mould Bay, Alert, Barter Island, Cold Bay, Fairbanks, and Thule AFB.

Under this agreement the Air Force has provided sounding equipment, expendable supplies (including special 1200-gram balloons), and reimbursement funds to the U. S. Weather Bureau (USWB) to cover operations through FY-61. The U. S. Weather Bureau operates all stations except Thule AFB. Beginning FY-62 the USWB has indicated that they will assume full responsibility for operation of these stations, except for the procurement of 1200-gram balloons, should their continued use during winter seasons be desired.

(b) Action Required.

Detailed performance data must be kept on the special 1200-gram balloons during the coming winter season. This is being accomplished by AWS and USWB. If the performance is satisfactory standardization action necessary to permit procurement through normal Air Force stocks must be taken by Air Force Cambridge Research Center.

Sufficient helium has been provided the rawinsonde unit at Ft. Churchill (for inflation of upper air balloons) to sustain operations through March 1961. The cost of shipment of helium for this operation is excessive. A possible solution is for USAF to provide hydrogen generator equipment. [redacted]

25X1

25X1

The above agreements have significantly improved the data collection network in the Arctic. The seven stations selected are considered the minimum number required to provide the necessary data; however, the overall adequacy of the network must be evaluated after the end of the current winter season (approximately March 1961).

(2) Rocketsonde Network.

(a) General.

The meteorological community has had little experience in the use of rocketsonde data for other than research purposes. Our knowledge of the atmosphere above 70,000 feet remains limited. The performance of the rocketsonde sensors is still questionable. One should not expect immediately a highly significant improvement in AWS capability to support operational systems as a result of the use of rocketsonde data. However, the importance of these data from a long range point of view is quite clear.

(b) Progress.

Two ground-launched meteorological rockets are currently being tested -- the Loki II developed by the Signal Corps and the ARCAS developed by the Navy. Presently these test firings are limited to Air Force, Army, Navy, and NASA test ranges located at Patrick, White Sands, Tonopah, Point Mugee, Wallops Island, Ft. Churchill, and Ft. Greely. The results to date are satisfactory, however, the tests are being delayed due to the low priority for firing assigned by the Test Centers.

ARDC is continuing development and testing work on instrument packages for the ARCAS rocket. These projects include the DMQ-6, Falling Sphere, and, an Applied Research Program on high altitude sensors. However, priorities established and funds allocated for these programs are quite low.

A meteorological rocket committee composed of representatives from the Army, Navy, U. S. Weather Bureau, NASA, and the Air Force is attempting to establish a Meteorological Rocket Network. Simultaneous firing at periodic intervals from the test sites mentioned above are being arranged to provide data sufficient for a synoptic analysis. NATO countries have expressed an interest in starting a NATO or UNESCO Meteorological Rocketsonde Network using the ARCAS rocket. The Soviet Union has a network, including both ground and ship stations [redacted] 25X1 25X1

(c) <u>Action Required</u>.

The Air Force has stated a requirement for meteorological data to [redacted] feet. 25X1 These data can be obtained at this time only by the use of the meteorological rocket. However, Air Force has not officially recognized the need for these data on an <u>operational</u> basis. <u>An Air Force document officially recognizing the need for meteorological data</u> [redacted] <u>feet on an operational</u> 25X1 <u>basis is required if the rocketsonde program is to progress beyond the research and test stages</u>.

Priority and fund allocations for the development and testing of the ARCAS meteorological rocket, established by ARDC and USAF, should be based upon the requirement to support advanced USAF systems on an operational basis as well as for support to Test Centers and research.

(3) Meteorological Satellite - TIROS.

(a) General.

The meteorological satellite provides the most effective means of obtaining data on cloud cover and distribution on a global basis; and in particular, over the Soviet Union and China where data are most limited.

New and improved sensors are available which will provide data under both light and dark conditions. These data will include cloud cover, long-wave radiation values (which convert to temperatures of the earth's surface and tops of clouds, moisture content and distribution), and some information concerning wind fields (which can be deduced from cloud motions).

(b) Progress.

TIROS I, launched by NASA, has proven the feasibility and usefulness of meteorological satellites. Immediately after the successful launch of TIROS I, the Air Weather Service established a program for using the cloud data on a limited operational basis. This program proved very successful, however, it was hampered by lack of adequate data handling and processing facilities.

NASA plans to launch two more experimental meteorological satellites (TIROS II and NIMBUS). Air Weather Service has submitted a plan to Air Force for an operational system composed of:

1. The satellite package containing sensors which scan in selected wave lengths; recording, storage, and transmitting equipment.

2. Ground equipment comprising data acquisition, communications, and rectification components.

3. Interpretation and evaluation facilities for the operational application of the data.

The components required to build an operational meteorological satellite are available. Depending upon the precedence established by Air Force, the system could be available in one to three years.

(c) Action Required.

A development program for a USAF Meteorological Satellite System should be established.

As an interim measure, data available from the experimental vehicles being launched by NASA should be exploited to the fullest. This will require ground handling facilities, such as described in "2" and "3" above. Data obtained from a meteorological satellite, coupled with that which may be gleaned from other reconnaissance vehicles, such as SAMOS, will be essential if we are denied meteorological information by the Soviet Union.

(4) Meteorological Reconnaissance Aircraft.

(a) General.

The current Air Weather Service reconnaissance fleet is composed of forty-three WB-50's, one WB-47, and one JB-57. The JB-57 was recently transferred from Wright Air Development Division to Air Weather Service. The WB-47 and JB-57 aircraft will be used largely as special support aircraft. All aircraft are equipped with flight level instrumentation and dropsonde equipment. The most serious limitation is the lack of a capability to obtain data above the aircraft flight level. The JB-57 is equipped with a rocketsonde dispenser which would permit continuation of rocketsonde flight test.

(b) Progress.

The research and development program in airborne meteorological instrumentation was almost entirely eliminated with the termination of the AN/AMQ-15 contract in November 1959. Most of the programs had reached the test and evaluation stage. A small applied research program is still active; however, it is limited to a few high altitude sensors. Possibly this program will produce suitable sensors for rocketsondes in approximately 18 months. The airborne launched rocketsonde program was cancelled at the end of the feasibility flight test phase. No further work is being done in this area.

The Air Weather Service is organizing a small Special Meteorological Reconnaissance Flight and Instrument Laboratory in the 55th Weather Reconnaissance Squadron at McClellan AFB. The unit will be concerned with special support to high priority Air Force projects. It will have the capability of handling special instrumentation problems on a small scale -- largely confined to the JB-57 and WB-47 aircraft. Much of the airborne equipment developed prior to termination of the AN/AMQ-15 program has been delivered to Air Weather Service [redacted] 25X1

[redacted] Test and evaluation of this equipment will be 25X1

continued to the extent that it can be accomplished by the instrument laboratory being set-up at McClellan. This equipment will be available for use on special projects should the test prove satisfactory performance.

(c) Action Required.

Complete the organization of the Special Reconnaissance Flight at McClellan AFB, and establish the instrument laboratory. This will be accomplished by AWS -- estimated date 1 January 1961.

A means of obtaining at least temperature and pressure data above the aircraft flight level is urgently required. Serious consideration should be given to re-initiating the development and testing work on the airborne rocketsonde.

A preliminary analysis indicates that it may be feasible to convert the AN/AMT-6 Dropsonde to an air-launched balloonsonde. Some development work with air-launched balloons has been done by Anderson, Greenwood and Company, Houston, Texas. The technique has been proven. Although the performance of such an instrument would not be comparable to the rocketsonde, it would provide a means of measuring temperature, pressure, and humidity from flight level to [redacted] feet (approximately equal to our present radiosonde capability). A distinct advantage would be its low cost. Further, if the conversion can be accomplished without changing the physical dimensions of the AMT-6 Dropsonde, no modification would be required to the aircraft dispensing and receiving equipment. Air Weather Service will investigate this approach further. If it proves feasible, a program will be proposed to USAF for conversion, test, and procurement. Flight test and evaluation can be performed by AWS. 25X1

(5) Data Acquisition Over the Soviet Union.

Since May 1st, the volume of upper air data above 50,000 feet, over the Soviet Union, available through normal weather channels, has been considerably reduced. The indications are that weather data from this area, essential to support hypersonic aircraft and satellites, will be further reduced. This places even greater emphasis on the requirement for adequate data over the Arctic.

(6) Communications Network.

(a) General.

To provide this type of support, it is not only necessary to obtain data of the type required, but it is also necessary to have a communications system which will provide the data from the area where it is collected to the place where it will be used. It is almost impossible to build a communications network that will bring all data from all places to one central point for analysis. Therefore, our communications network must be flexible so that we can, upon very short notice, change our data flow, as directed by operational objectives. In addition, the communications network must be capable of timely delivery of the required information.

(b) Progress.

Our communications network, as it is established today, is still a little short of our requirements. One of the bottlenecks we have is in editing out extraneous material at our collection centers before putting the data on long haul circuits. This has to be accomplished manually at the present time and, while quite time consuming, is much better than trying to leave the excess data in the weather messages and paralyzing the long haul circuits. We are on the track of some rather inexpensive electronic data sorting equipment which appears capable of accomplishing this task with insignificant time delays. There should be no problems in

obtaining such equipment as the savings in manpower should more than offset the cost. However, there always seem to be people who fight progress, so we may require some assistance in helping expedite the procurement of these devices if we get bogged-down with indecisions. We will keep you advised of our progress.

Another potential problem in the communications area is in connection with the communications network design for System 433-L (Weather Observing and Forecasting System). The 433-L ESSPO is exerting considerable pressure to obtain a decision that a common FAA/USAF communications network should be the basic design concept. A decision by Air Force to rely upon weather communications support from a system operated and controlled by civil agencies may be premature and could result in degrading our support to this operation (we would lose a lot of our flexibility and fast reaction time). It is expected that this matter will be taken under consideration by Hq USAF very soon and a decision rendered sometime next month (October). We are on top of the situation at the moment, but should developments indicate an impasse in project support, we may need some assistance.

c. Electronic Data Processing Facilities.

(1) Progress.

There has been considerable slippage in the procurement of the 7090 computer for Offutt Weather Central. This has been primarily because of the Hq USAF delay in getting the contract agreement processed and the inability of IBM to deliver the units; however, the computer arrived at Offutt on 20 September 1960. Installation and check-out of the equipment should be completed by 1 January 1961. Programs have been written and tested which will prepare automatic weather chart analyses up to the 30-mb level for the northern hemisphere, which is basic to the programs to get us [redacted] We have a lot of work to do yet on programming and may have to depend upon manual processes of weather forecasting for the initial phases of the flight test programs. However, the use of the computer for the less complex weather problems will release manpower for use on both programming and manual analysis. 25X1

One major problem area which appears in the use of the computer is the lack of suitable input and output processing equipment. A tremendous volume of data (approximately 100,000 individual reports) must be put into the computer each day. There is also a vast amount of data coming out of the computer. In our request for the computer we requested some type of fast input-output equipment. USAF did not

fully understand the problem and did not approve this request. Air Weather Service rejustified the requirement but USAF still did not approve. We did not find out about this problem until a couple of months ago and have been able to get it straightened out -- i.e., the necessary USAF approval to procure an IBM 1401 data processer. IBM now has the necessary procurement documents to start building the machine, but will not be able to deliver until August 1961. Unless we can steal someone else's 1401, we will be somewhat comparable to the fellow with a Cadillac who only has an eyedropper to put the gas in the tank -- it runs good when you finally get a tank full, but it sure does take a long time to fill up the tank.

(2) Action Required.

Steal an IBM 1401! This can be legally done by obtaining a high defense priority; however, we should wait until the computer is installed and operational before we will be in a position to establish a priority.

4. Meteorological Support to Project O. (Reference Tabs A through D.)

a. Preliminary Design Study.

This study has been completed and copies provided the USAF Project Office and the contractor. (See Tab D) The limited data available at [redacted] feet prohibited a detailed analysis; however, 25X1
it is understood that the data were sufficient for design purposes.

b. <u>10-MB Analysis Program</u>.

Support of the hypersonic aircraft will require routine analysis [redacted] The most critical problems are: 25X1
(1) lack of data at the 10-mb level over the geographical areas of interest, (2) low experience factor in conducting analyses at the [redacted] and (3) limited knowledge concerning atmospheric conditions and processes at this level. To improve the AWS capability in this regard, the following programs have been established: 25X1

(1) <u>U. S. Weather Bureau 10-MB Research Program</u>.

A series of [redacted] analyses made at 10-day intervals for the 1957-1958 period have been obtained from the USWB. These charts have been provided the Offutt Weather Central for study and training. Arrangements have been made with the USWB to conduct a similar analysis program at 5-day intervals, for the 1958-1959 period. These will be available approximately 1 December and will be provided Offutt Weather Central. 25X1

This program is being financed jointly between the Navy and the Air Force. Air Force contribution was $10,000. These charts represent the most valuable and competent work done to date at the [redacted] 25X1

(2) Offutt Weather Central 10-MB Program.

A training program is underway. Subjective analyses are being accomplished for training purposes, although not on a routine basis. Routine analysis will begin at least 90 days prior to the test operational date of Project O. Extrapolation and graphical analysis techniques are being developed. Upon completion of the installation of the 7090 computer, experiments with numerical prediction models will be conducted.

c. Meteorological Support at Operating Location.

(1) Progress.

A preliminary planning document has been submitted (See Tab D). Air Weather Service has incorporated this requirement in the UMD (this allocates manpower spaces and serves as the basis for equipment requisitions) and personnel selection has begun. A requirement for a mobile rawinsonde section has been levied. Preliminary planning for support by Offutt Weather Central is in progress. A survey of all meteorological facilities within a radius of 600 miles of the operating location is being conducted to determine the extent of specialized support which can be obtained during the test phase.

(2) Action Required.

(a) A site survey should be conducted at an early date to:

1. Select the installation site for surface and upper air observing equipment and prepare installation drawings.

2. Inspect physical facilities.

3. Survey communications facilities at the operational base and other bases in nearby areas so that final meteorological communications plans can be prepared.

(b) Program and requisition required equipment and supplies.

(c) Program required meteorological communications facilities.

(d) Prepare final plans for building facilities.

(e) Prepare plans for maintenance and supply facilities.

(f) A USAF directive should be provided Air Weather Service to be used as a basis for program actions.

d. Meteorological Support Concept for Project O.

(1) General.

Before a detailed meteorological support program can be developed, a preliminary operational concept must be provided Air Weather Service. From a meteorological point of view, this should include:

(a) Mission planning.

(b) Flight profiles.

(c) Refueling program.

(d) Degree to which flight will be automatically programmed.

(e) Recovery.

(f) Emergency procedures.

(g) Reconnaissance requirements.

(2) Action Required.

AWS should be provided the operational concept as soon as possible in order to permit us to start work on this phase of our support. This operational concept should include the above listed operational concept.

e. Mathematical Analysis of Aircraft Performance vs Meteorological Variability.

(1) General.

In order that the meteorological influences can be more specifically defined, a complete mathematical analysis of a simulated mission should be performed. It is known, for example, that the variation of temperature at [redacted] feet may be greater than the standard atmosphere value on a given mission. We need to know precisely how such changes may affect aircraft performance, hence mission accomplishment, i.e., do temperature gradients exist which may be critical from the standpoint of control and/or performance? 25X1

Convair, General Dynamics Corporation, Ft. Worth, Texas is currently engaged in work of this nature relative to the B-58. In-flight thrust tests have recently been completed. A request for results of these tests, and associated mathematics, was forwarded to Convair. Their reply indicates the material will be provided Air Weather Service approximately 7 October.

Information of this nature will define more precisely the forecast problem, meteorological information format, etc. It appears that an analysis of this type can be conducted by transforming the fundamental performance equations in terms of the significant meteorological variables. Some preliminary work has been done by the

Air Weather Service, however, specific performance equations must be obtained from the designer. Once the problem has been defined mathematically, the evaluation will be conducted by Air Weather Service.

To perform this evaluation, more detailed meteorological data will be required than is currently available. The primary area of concern is the Arctic region. The two conditions considered most important are the cold stratospheric vortex and intense stratospheric warming. These represent the extreme conditions most likely to be encountered.

At present, the Air Weather Service does not have the capability to collect the detailed data required to an altitude of [redacted] Since we are concerned with detailed temperature profiles, the data can only be obtained through the use of reconnaissance aircraft, or possibly constant level balloons, complemented by radiosonde observations.

(2) Action Required.

AWS will make a concerted effort to obtain the necessary data to permit a detailed analysis of the cold stratospheric vortex, and a stratospheric warming situation, during the coming winter season. This project will require the use of the WB-50, WB-47, JB-57, and U-2 aircraft operating out of Eielson AFB, Alaska. The flights will be

planned so that simultaneous observations would be obtained at the operating altitude of each aircraft. These data would then be integrated with those obtained from the Arctic radiosonde network. The possibility of flying a constant level balloon at [redacted] feet 25X1 during the same period will also be investigated.

The data obtained from the above program would be used to perform an analysis of a simulated mission. An evaluation of this analysis should be conducted during the flight test program for the hypersonic aircraft.

An Air Force precedence should be established for the above AWS program to insure its accomplishment during the coming winter season. Prior to initiating this program, a lightweight doppler navigator should be installed in the JB-57 aircraft. These units are available through the depot. The engineering has been accomplished. With an Air Force precedence established for the program the installation could be complete in 10 days.

f. <u>Flight Test Program.</u>

(1) <u>General</u>.

The finalization and evaluation of the meteorological support program must be accomplished during the flight test phase. The flight test program should be made available to the Air Weather Service as early as possible to permit adequate planning. From a

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meteorological point of view the major objectives appear to be:

(a) Evaluation of forecast techniques and application procedures.

(b) Final evaluation of data acquisition, communications, and processing facilities.

(c) Evaluation of environmental influences upon the aircraft and mission effectiveness. Examples are:

1. Effect of variability of ambient temperature upon aircraft performance, hence mission effectiveness.

2. Turbulence and wind shear effects.

3. Wind effects upon mission performance.

4. Contrail formation and prediction techniques.

5. Atmospheric effects upon intensity of shockwave.

6. Atmospheric effects upon refueling mission. (If meteorological reconnaissance is required, it should be initiated early so as to arouse the least suspicion.

(2) Action Required.

The flight test program should be made available to AWS as soon as possible. In fact, AWS should work quite closely with the contractor in preparing the flight test program. It is impossible to over-emphasize the importance, to the success of the project, of such a close working relationship.

5. Meteorological Support Program for Satellite Operations Project C.

a. General.

The impact of the satellite vehicle upon our military posture and national security is now quite clear. Projects SAMOS, DISCOVERY, MIDAS and others are in the final stages of development and testing -- although engineering refinements will continue.

We again find that the effectiveness of these systems is dependent to a large degree upon the natural environmental conditions -- in some cases, decisive.

The use of satellites as detection, surveillance, and photographic reconnaissance vehicles presents many new problems in the application of meteorological information. A detailed treatment of these problems and action being taken by AWS is contained in Tab E. In general, the support requirements may be defined as follows:

(1) Data Requirements.

The data requirements are not new -- the most significant ones, as listed below, are those with which we have dealt the longest.

(a) Cloud type, cover, and distribution over target areas.

(b) Snow cover over target areas.

(c) Weather conditions affecting launch -- clouds, winds, and severe weather.

(d) Weather conditions affecting recovery -- clouds, winds, refractive index, temperature, severe weather, visibility, and state-of-the-sea.

(2) Climatology.

A detailed climatology of cloud cover and distribution over the target areas is required to: (1) insure proper trade-offs as regards resolution, power requirements, useful life, size of film package, storage and read-out capability, etc., are made, (2) determine frequency and period of launch, and (3) establish sound procurement programs. The climatological expectancy is also an important factor in the preparation of forecast to determine the camera control program.

(3) Forecast Programs.

(a) Planning.

In the use of satellites, the high cost per bit of information places added emphasis upon the accuracy of the planning forecast. The objective is to choose a launch time which will insure the highest probability of success, both in obtaining useful intelligence information and recovery.

(b) Launch.

This is essentially a conventional terminal forecast, i.e., weather conditions which may affect launch or range safety.

(c) Recovery.

Forecast conditions in the recovery area is a primary factor in determining the launch time, hence, a long range forecast is required initially. A premium is placed upon the accuracy of the forecast at the time of recovery. The most important factors are clouds, visibility, weather, state-of-the-sea, and winds aloft as they affect the sighting and recovery of the re-entry package.

b. Progress.

(1) Status of Current Air Weather Service Task Assignments.

Generally, the Air Weather Service activities have been tasked to provide support as follows:

(a) Offutt Weather Central.

Prepares all forecasts for target areas, planning forecasts for launch and recovery as required, and provides consultant service for the Project Meteorological Briefing Section and the Detachment at the Satellite Test Wing. The Project Meteorological Briefing Section prepares and presents meteorological briefings and provides consultant service to the Project Office.

(b) Staff Meteorological Division at BMD.

Provides consultant service to the Satellite Project Offices and Prime Contractors.

(c) Meteorological Detachment at the 6594th Satellite Test Wing, Palo Alto, California.

This group prepares launch forecasts and provides meteorological service to the Test Wing.

(d) Forecast Center, Honolulu, Hawaii.

This unit prepares recovery forecasts and provides meteorological service to the radar and recovery aircraft.

(e) Reconnaissance Support.

The Air Weather Service currently operates three WB-50's and one B-47 reconnaissance aircraft in support of each DISCOVERY shot. These aircraft perform weather reconnaissance missions between California and Hawaii, and in the recovery area. Since recovery is effected over ocean regions, the reconnaissance aircraft provide the majority of the meteorological data.

(2) Techniques Development and Study Program.

The development of a meteorological support program for satellite operations presents many new problems. New approaches to cloud-forecasting are required. Looking down on cloud formations from an altitude of 100 to 300 miles, as opposed to looking up from the surface of the earth, proposes problems in geometry. The application of meteorological information in a decision-making program designed to control the photographic system to insure maximum "take" offers many interesting problems. And finally, the analysis, prediction, and application techniques must be transformed to computer programs. A number of technique development and study programs are now underway.

(a) Application of Meteorological Data to Satellite Operations.

A decision-making program is under study whereby the computer will periodically assess the number of potential targets,

the priorities, the cloud forecasts, climatic expectancies, and the amount of available film to arrive at a decision as to when and when not to photograph in order to maximize the efficiency of the operation.

(b) Cloud Forecast Programs.

A two-dimensional trajectory forecast program utilizing the hourly history tapes completed for the [redacted] 25X1
Modification to adapt this program to [redacted] will be 25X1
completed by 15 October. Refinements to include vertical motions are contemplated prior to 1 July 1961. An evaluation of the extent to which cloud patterns at the beginning of a trajectory maintain their identity throughout the trajectory path will be tested on current data, beginning 15 October 1960.

A machine program for extrapolating cloud patterns using past continuity is under development. Target date - 1 July 1961.

A technique for predicting cloud patterns through the use of temperature and pressure fields at [redacted] is 25X1
being evaluated at Offutt Weather Central.

A detailed study of the cloud patterns and structure as received from the satellite is planned. This would involve:

1. A correlation between the normal surface weather observation and the degradation of photographic capability due to clouds as viewed by the satellite.

2. The degree of degradation of satellite photography as a result of intervening clouds of different types.

3. A correlation between cloud patterns and distribution and analyzed temperature, wind, pressure, and vertical motion fields at different levels.

4. Analysis of the mean percentage of the earth's surface covered by cloud.

A special reconnaissance program is planned using the JB-57, and U-2 if available, to obtain cloud photographs and meteorological data necessary to evaluate new forecast techniques being developed.

(c) Climatology.

A detailed climatic program is being developed to provide the necessary climatological information to support design, development, and planning programs for satellite operations. An attempt is being made to develop these data in a form suitable for the satellite family, as well as other weapons systems. The program will be confined to the Communist Bloc area, at least initially.

c. Action Required.

The importance of satellite operations from a national security point of view cannot be over-estimated. The meteorological factors are of primary importance if we are to insure maximum effectiveness. The Air Weather Service work listed under Techniques Development must be continued and expanded to include results from reconnaissance vehicles. To accomplish this we must:

(1) Obtain clearance for a limited number of personnel to have immediate access to the actual "take."

(2) Dependent upon the preliminary studies of the results, develop an overall AWS program to utilize this information.

As previously pointed out, our whole concept of meteorology, from the recording of the observation to the final forecast and climatological program, must be re-evaluated and adjusted to incorporate these revolutionary changes. This will be no small task!

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EXTRACT OF ACTION ITEMS FOR USAF PROJECT OFFICE

1. Provide necessary direction and/or authority and precedence for implementation of the Air Weather Service action items outlined in this report.

2. Reference page 5 -- obtain an Air Force document officially recognizing the need for meteorological data above 25X1 on an operational basis. This document should be provided ARDC to be used as a basis for priority and fund allocation for development and testing of the ARCAS meteorological rocket. (Copy should also be provided AWS for planning purposes.)

3. Reference page 7 -- advise key Air Staff personnel of the need for meteorological satellite data to support Projects O and C.

4. Reference page 14 -- assist Air Weather Service in expediting the procurement of an IBM 1401 for use at the Offutt Weather Central.

5. Reference page 17 -- arrange for a site survey at the operating location for Lt. Col. Gaertner and Maj. Smith.

6. Reference page 17 -- provide Air Weather Service with a project directive to be used as a basis for program actions. This directive should contain a priority and precedence.

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(Extract of Action Items for USAF Project Office - Continued)

7. Reference page 18 -- provide Air Weather Service with an Operational Concept for Project O.

8. Reference page 22 -- provide Air Weather Service with a Flight Test Program for Project O, or arrange for AWS representative to work closely with the Project Office and contractor in developing the flight test program.

9. Reference page 29 -- obtain clearances and access authority for a limited number of AWS personnel to perform a meteorological analysis of Project C "take."

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REPORT OF AWS TASK TEAM ON METEOROLOGICAL SUPPORT TO MILITARY SATELLITE SYSTEMS

WDLRM 60-14

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REPORT OF THE AIR WEATHER SERVICE TASK TEAM ON

METEOROLOGICAL SUPPORT TO MILITARY SATELLITE SYSTEMS

I. INTRODUCTION:

The purpose of this meeting was to bring together those Air Weather Service agencies presently or soon to be involved in direct support of the operation of military satellite systems. The objective of this first meeting held at the Air Force Ballistic Missile Division was to formulate and propose standard solutions to those support problems identified by the 4th Weather Group.

Proper meteorological support to any operation requires an integrated program including the planning, test and employment phases of the operation. The design of those systems or components which are susceptible to atmospheric effects must be based on a full and proper consideration of climatological data in order to maximize the unconditional probability of success of the system. When the unconditional probability of success is below acceptable limits, the design should allow for sufficient employment flexibility in order to take account of forecast meteorological conditions which can be used to maximize the expected success on each individual attempt. This type of meteorological data application results in maximum utilization of the service that can be provided, and at the same time, fixes the requirement for the forecasting and other programs far enough in advance to allow for appropriate techniques or program development to be undertaken and completed.

The area of satellite operation is one in which immediate action should be taken by Air Weather Service to develop a capability for full meteorological support. These vehicles are unquestionably destined to assume a major role in future Air Force operations. Their potential value as a reconnaissance vehicle is enormous. Their usefulness as communication and navigational devices are also of great military significance.

These systems are, however, by far the most expensive devices ever considered for routine employment. This fact demands that every effort be made to enhance the effectiveness of each mission. It is for this reason that a sound meteorological support program which is well executed should be able to effect considerable savings in the cost of and the use of these systems.

The program for this initial meeting consisted of the following objectives:

a. Define the planning, R and D test and employment problems in which meteorological factors are a consideration.

b. Analyse the meteorological data requirements for optimum planning, test and employment.

c. Discuss the adequacy of present climatological and forecast capability with regard to support requirements.

d. Outline a program for the provision of specific support requirements, and identify technical problems requiring a solution.

Personnel from each of the operating weather service agencies presently or soon to be involved in support to these satellite systems participated as members of this task team.

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A list of these individuals and their organization follows:

Col Gene Drubek	3rd Weather Wing
Lt Col John Allen	3rd Weather Wing
Lt Col Adolph Gaertner	Hq Air Weather Service
Mr Max Edelstein	4th Weather Group
Major Daniel E McPherson	Staff Meteorologist, AFBMD (4th Weather Group)
Major Roger Arnold	AWS Climatic Center
Major James A Smith	Hq Air Weather Service
Major Charles F Roberts	Hq Air Weather Service
Capt Leo Stempson	6594th Test Wing (4WG)

The following personnel assigned at the Air Force Ballistic Missile Division participated in meetings of this group:

NRO 25X1

[redacted]	AFCRC Liaison Officer
	Director Satellite Systems Operational Employment
	Chief, SAMOS Satellite Systems Payload Division
	Chief, MIDAS Satellite Systems Division
	Test Evaluation Branch Space Systems Test Division

There were a number of satellite systems presently under development under Ballistic Missile Division responsibility whose meteorological support requirements were not considered. Those systems such as MERCURY, DYNASOAR, etc., are not clearly identified as military systems, and the task team felt that these systems should not receive the attention at this time that is demanded by those systems with a stated military role.

The development and formulation of the meteorological support requirements for each system is given according to program phase. The problem was outlined in this manner for the reason that the requirements on each phase tends to fall into the responsibility of one of the operating weather agencies. Furthermore, a number of our support requirements in a given phase were nearly the same for all systems. For example, the launch requirements for nearly all vehicles are of the same general form.

II. ANALYSIS OF METEOROLOGICAL REQUIREMENTS FOR EACH OF THE SATELLITE PROGRAMS.

1. DISCOVERER PROGRAM

The DISCOVERER program consists of the design, development and flight-testing of 29 two-stage vehicles using the THOR ICBM a first stage booster and the AGENA vehicle, powered by the Bell LR61 rocket engine series as the second stage satellite. The DISCOVERER Program was established early in 1958 under direction of the Advanced Research Projects Agency, with technical management assigned to AFBMD. On 14 November 1959, program responsibility was transferred from ARPA to the Air Force by the Secretary of Defense. Prime contractor for the program is Lockheed Missile and Space Division. The DISCOVERER Program will provide: (a) space research in support of the advance military reconnaissance satellite systems programs, (b) test of the ground communications and tracking network for these programs, and (c) flight testing of the AGENA second stage vehicle.

Primary objectives include:

(a) Flight test of the satellite vehicle airframe, propulsion, guidance and central systems, auxiliary power supply, and telemetry, tracking and command equipment.

(b) Attaining satellite stabilization in orbit.

(c) Obtaining satellite internal thermal environment data.

(d) Testing of techniques for recovery of a capsule ejected from the orbiting satellite.

(e) Testing of ground support equipment and development of personnel proficiency.

(f) Conducting bio-medical experiments with mice and small primates, including injection into orbit, re-entry and recovery.

Early tests confirmed vehicle flight and satellite orbit capabilities, developed system reliability and predictability, and established ground support, tracking and data acquisition requirements. Subsequent flights are planned to acquire scientific data for design of advanced military reconnaissance payload components. Typical data gathering objectives include: cosmic and atomic radiation, magnetic field, total electron density, auroral radiation, micro-meteorite measurement, Lyman alpha from space (or stars), solar radiation, atmosphere density (drag) and composition.

A world-wide network of control, tracking, and data acquisition stations has been established. Overall operational control is exercised by the Control Center in Sunnyvale, California. Blockhouse and launch operations are performed at the Vandenberg Air Force Base Control Center.

Telemetry ships are positioned as required by the specific mission of each flight. An additional objective of this program is the development of a controlled re-entry and recovery capability for the payload capsule. An impact area has been established near the Hawaiian Islands and a recovery force activated. Techniques have been developed for aerial recovery by C-119 aircraft and for sea recovery by Navy and Air Force surface vessels.

REQUIREMENT	COMMENTS & RECOMMENDATIONS
A. Planning Phase: Completed	
B. Test Phase:	
(1) Weather support to insure successful launching and meet range safety criteria.	B(1) Standard local forecasts. Responsibility: 4th Wea Gp (6594th Test Wing)
(2) Weather support to data readout operations.	(2) Storm warnings and severe weather advisories. Responsibility: Appropriate weather agency.
(3) Weather support to capsule recovery operations.	(3) Area cloud and weather forecasts. Dusting phenomena. Responsibility: 1st Wea Wg.
C. Operational Phase: No operational phase is planned for DISCOVERER.	

2. MIDAS PROGRAM

The MIDAS Program was included in Weapon System 117L when WS-117L was transferred to the Advanced Research Projects Agency early in 1959. ARPA subsequently separated WS-117L into the DISCOVERER, SAMOS and MIDAS Programs, with the MIDAS objectives based on an [redacted] The MIDAS (Missile Defense Alarm System) Program was directed by ARPA until transferred to the Air Force on 17 November 1959. Development activities have led to the first of a ten flight R & D program in March 1960 with a reliable operational system achievable by 1962-1963. 25X1

The MIDAS [redacted] will be engineered to use a standard booster-satellite launch vehicle configuration consisting of an ATLAS "D" missile as the first stage, and the 25X1

AGENA vehicle, powered by a Bell-Aircraft rocket engine as the second, orbiting stage. Refinements to the AGENA vehicle will be made as a result of the DISCOVERER flight test program. The total payload weight is approximately 1,000 pounds. The ATLAS/AGENA configuration with single restart capability and large propellant tanks can place a payload of 1,500 pounds on 2,000 nautical mile altitude polar orbit. Only the first two R&D flight tests will use the single capacity AGENA vehicle.

The first two MIDAS R&D tests are to be launched at the Atlantic Missile Range. Subsequent tests and operational vehicles are to be launched from Vandenberg AFB, California. The command decisions in the R&D phase are to be made at the Satellite Test Center, Sunnyvale, California. Control of the operational vehicles will be the responsibility of Air Defense Command. These commands involve the scanning function (range and tilt), [redacted], the readout and the attitude control. 25X1
Certain aspects of the command decisions and definition of the background [redacted] require advice on meteorological conditions. 25X1

The MIDAS Program system is designed to provide continuous infrared reconnaissance of the Soviet Union. Expansion of this capability to other land and ocean areas appears likely. Surveillance will be conducted by eight satellite vehicles in accurately positioned orbits. The area under surveillance must be in line-of-sight view of the scanning satellite. The satellite operating altitude is determined by system [redacted] 25X1
design. The system is designed to accomplish instantaneous

readout of acquired data by at least one of three strategically located readout stations. The readout stations transmit data directly to the MIDAS Control Center and other display centers, where they are processed, displayed, and evaluated. If an attack is determined to be underway, the intelligence is communicated to a central Department of Defense Command Post for relay to the President and all national retaliatory and defense agencies.

REQUIREMENT	COMMENTS & RECOMMENDATIONS
A. Planning Phase: Completed	
B. Test Phase: (1) Weather support to insure successful launch and satisfy range safety criteria.	B(1) Standard local forecast. Responsibility: 4th Wea Gp and 3rd Wea Wg (Detachment at launch site.)
(2) Global weather and cloud data necessary to analyze [redacted] in order to assist in interpretation of MIDAS detection system.	(2) Cloud observations (radar, Sferics, etc) and forecasts. Responsibility: 4th Wea Gp (6594th Test Wing) and 3rd Wea Wg. 25X1 25X1
C. Operational Phase: (1) Aside from launch support requirements involved in satellite replacement operations, the support requirements will have to be defined from analysis of test R&D program results.	C(1) To be determined. Responsibility: 4th Wea Gp.

25X1

[redacted]

(2) Global cloud forecasts. Responsibility: 3rd Wea Wg.

3. SAMOS PROGRAM

The SAMOS Program was included in Weapon System 117L when WS-117L was transferred to the Advanced Research Projects Agency early in 1958. ARPA separated WS-117L into the DISCOVERER, SAMOS, and MIDAS programs with the SAMOS objectives based on a visual and ferret reconnaissance system. On 17 November 1959 responsibility for this program was transferred from ARPA to the Air Force by the Secretary of Defense.

The primary mission of the SAMOS advanced reconnaissance system is to provide continuous visual, electronic (and other) surveillance of the USSR and its allied nations. Efforts include development of hardware to permit:

(a) Determination of characteristics of enemy electronic emissions.

(b) Verification of known targets and detection of unknown targets.

(c) Location and evaluation of defenses.

(d) Evaluation of military and industrial strength.

(e) Assessment of high-yield weapons damage.

(f) Reconnoitering of troop movements.

(g) Location of naval forces throughout the world.

The reconnaissance equipment will be housed in the AGENA satellite vehicle which has been flight tested in the DISCOVERER program. During the development phase a dual-capability visual and [redacted] will be developed for economical test of components. 25X1 In the operational phase each satellite vehicle will carry only the visual or the [redacted] The current concept is that there 25X1 will be two of each satellite vehicles in orbit continuously. The system is composed of the satellite vehicle, ATLAS booster, launch facilities, tracking facilities, and a communications and data processing network.

In the operational SAMOS Program, AGENA satellite vehicles will be boosted into polar orbits from Point Arguello, California by Series D ATLAS missiles. Injection into near-circular orbits will be accomplished by the AGENA vehicles rocket engine. The satellite will be stabilized in attitude by a self-contained guidance system using a horizon reference scanner. As the satellite travels in an orbit essentially fixed in space, the earth rotates inside the orbit. As a result, each successive orbit is displaced laterally, approximately 22½ degrees at the equator, permitting a single vehicle to observe the entire earth in a time period dependent upon the width of the area under surveillance. Early versions will have a useful life of ten to thirty days. Later versions will have a useful life of one year as a design objective.

Cameras with 6 and 36 focal length lenses have been developed and the first flyable visual reconnaissance package has been assembled.

This package includes automatic film processing equipment, film transport and take-up, electronic readout and temperature controls.

Visual reconnaissance system payloads are being developed in a minimum number of configurations to attain readout and recovery mission objectives. The designation and purpose of each configuration is as follows:

E-1 - Component Test Payloads

E-2 - Steerable Reconnaissance Payload (with 20-foot ground resolution).

NRO 25X1

E-5 - High Resolution Recoverable Payload [redacted]

NRO 25X1 [redacted]

[redacted] payloads are being developed in two phases. The F-1 payload was assembled using a maximum of off-the-shelf components for early availability. The F-2 payload is being designed for maximum performance. The F-1 payload has undergone extensive flight testing, mounted in an aircraft, over U. S. radars. The results have been excellent. 25X1

The first R & D test article is scheduled for launch in September 1960. The operational capability is scheduled to be achieved in the 1962-63 time period. The readout capability is limited to approximately 84 minutes per day. The times at which sensors are programmed to be turned on thus becomes extremely important in order for the system effectiveness to be maximized. Commands to scan and readout will be influenced by the knowledge of any obscuring phenomena.

Recovery of some E system capsules may be effected in the Hawaiian Recovery Area currently used in the DISCOVERER test program. Later recovery may be accomplished in mid United States area.

In the R & D phase the Satellite Test Center, Sunnyvale will be the location of the decision making organization. The Satellite Operational Control Center at Offutt AFB will be the location of the decision making organization in the operational phase.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
A. Planning Phase:	
(1) Meteorological information necessary to analyze expected success of current system concept, and necessary to formulate changes in system concept in order to improve expected success.	A(1) Climatological data on clouds and observing phenomena. Responsibility: AWS Climatic Center support from AWS ADPS GWC).
(2) Meteorological data necessary to develop suitable employment tactics.	(2) Climatological data on clouds & observing phenomena. Forecast capability data. Responsibility: AWS Climatic Center, AWS (ADPS GWC).
B. Test Phase:	
(1) Weather support to insure successful launch and satisfy range safety requirement.	B(1) Standard local forecast. Responsibility: 3rd Wea Wg.
(2) Global meteorological data necessary to evaluate payload equipment performance.	(2) Post analysis of cloud and obscuring phenomena. Responsibility: 4th Wea Gp and 3rd Wea Wg.
(3) Global meteorological data necessary to evaluate degradation of mission accomplishment by atmospheric effects. (E subsystems only)	(3) Post analysis of cloud and obscuring phenomena. Responsibility: 4th Wea Gp, 3rd Wea Wg, other weather agencies.

(4) Global meteorological forecasts to optimize payload performance (E subsystems only).

(4) Global forecasts of cloud and obscuring phenomena. Responsibility: 3rd Wea Wg (GWC), 4th Wea Gp (6594th Test Wing)

(5) Evaluation of meteorological support techniques (E subsystems only).

(5) Forecasts supplied on cloud obscuring phenomena will be checked against satellite observations. Responsibility: 3rd Wea Wg and 4th Wea Gp.

(6) Weather support to capsule recovery operations (E-5 subsystem only).

(6) Cloud and weather forecasts in recovery area. Responsibility: 1st Wea Wg and others as required.

(7) Weather support to data readout operations.

(7) Severe weather advisories. Responsibility: Supporting AWS unit.

(8) Certain additional geophysical data requirements associated with communications transmission may be involved in F subsystems.

(8) To be determined. Responsibility: 4th Wea Gp.

(9) Meteorological data for support of geodetic mapping system test may be included in later phases of SAMOS test program.

(9) To be determined. Responsibility: 4th Wea Gp.

C. Operations Phase:

(1) Weather support to insure successful launch and satisfy range safety requirement.

C(1) Standard local forecast. Responsibility: 3rd Wea Wg.

(2) Continuous global meteorological data and forecasts necessary for maximizing the amount of useful intelligence received from each vehicle expended. (E subsystems only)

(2) Global forecasts of cloud and obscuring phenomena. Responsibility: 3rd Wea Wg (GWC).

(3) Weather support to capsule recovery operations (E-5 subsystem only)	(3) Cloud and weather forecasts in recovery area. Ducting phenomena. Responsibility: 3rd Wea Wg.
(4) Weather support to data readout operations.	(4) Severe weather advisories. Responsibility: Supporting AWS unit.
(5) Meteorological data necessary to evaluate success of employment tactics and the adequacy of meteorological support program.	(5) Forecasts supplied on cloud and obscuring phenomena will be checked against satellite observations. Responsibility: 3rd Wea Wg.

4. COURIER COMMUNICATIONS SATELLITE PROGRAM

The COURIER is an ARPA program to test delayed repeater communications between a satellite and ground stations. The present schedule calls for two vehicles to be launched by July 1960. The program will also be used to determine the operational characteristics and capabilities of the ABLE-STAR second stage vehicle.

The Army Signal Research and Development Laboratories will design, develop and fabricate the payload and will be responsible for world-wide ground station requirements.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
A. Launch Phase	A. Standard observation and forecast data are needed to insure the launch environment is within specified system and range safety minima.
B. Orbit Phase	B. Preliminary analysis indicates no meteorological support requirements. Certain geophysical data associated with communications transmission, e.g., the refractive effect of the ionosphere on radio transmissions, may be required.

5. TRANSIT NAVIGATION SATELLITE PROGRAM

The TRANSIT program consists of four flights of satellites designed to provide accurate, world-wide, navigational information for use by aircraft, surface and subsurface vessels. One vehicle has been launched. The remaining flight tests in the present program are scheduled in 1960. The primary objectives of the program are:

(a) To provide accurate reference information for POLARIS missile navigation accuracy.

(b) Precise determination of satellite position through use of payload transmitted radio signals (doppler shift measurement).

(c) To investigate the refractive effect of the ionosphere on radio transmissions.

(d) Acquire additional geodetic and geophysical information by precision tracking of the satellite in orbit.

ARPA has retained responsibility for operating, tracking, recording and processing all satellite data.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
A. Launch Phase:	A. Standard observation and forecast data are needed to insure the launch environment is within specified system and range safety minima. The capability exists at present to meet this requirement.
B. Orbit Phase:	B. Preliminary analysis indicates no meteorological support requirements. Certain geophysical data associated with communications transmission, e.g., the refractive effect of the ionosphere on radio transmissions, may be required.

6. STEER COMMUNICATIONS SATELLITE PROGRAM

The STEER Communications Satellite Program will investigate the feasibility of using synchronously spaced satellites as instantaneous repeaters for radio communications. Four vehicles are programmed to be launched in the present program starting in October 1961. AFBMD is responsible for design, development and test of the complete system including launch, satellite tracking and control, and necessary support facilities and units. WADD is responsible for the development of aircraft communications equipment, satellite and ground station communications equipment. ATLAS-AGENA vehicles will be used to inject satellites into polar orbits with six-hour orbital periods. The program objectives include:

(a) Provision of a single channel, two-way voice communication repeater between ground stations in the United States and airborne strike forces of the Strategic Air Command flying alert missions in northern latitudes.

(b) Development of engineering concepts and equipment and furnish test support data for DECREE.

(c) Investigation of the effects of vacuum and radiation environment on satellite components over an extended time period.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
A. Launch Phase:	A. Standard observation and forecast data are needed to insure the launch environment is within specific system and range safety minima. The capability exists at present to meet this requirement.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
B. Orbit Phase:	B. Preliminary analysis indicates no meteorological support requirements. Certain geophysical data associated with communications transmission, e.g., the refractive effect of the ionosphere on radio transmissions, may be required.

7. DECREE COMMUNICATIONS SATELLITE PROGRAM

The DECREE is a follow-on of the STEER Communications Satellite Program to demonstrate the feasibility of a global communications system, using precisely spaced "hovering" satellites which, essentially, have orbital periods of 24 hours. Ten flight tests are scheduled in this phase. Responsibilities are the same as stated for the STEER System except that the Army Signal Research and Development Laboratory has responsibility for satellite and ground station communications equipment. A launch trajectory has been selected for the ATLAS/CENTAUR vehicle using an azimuth of approximately 10 degrees south of due east.

REQUIREMENTS	COMMENTS & RECOMMENDATIONS
A. Launch Phase:	A. Standard observation and forecast data are needed to insure the launch environment is within specific system and range safety minima. The capability exists at present to meet this requirement.
B. Orbit Phase:	B. Preliminary analysis indicates no meteorological support requirements. Certain geophysical data associated with communications transmission, e.g., the refractive effect of the ionosphere on radio transmissions, may be required.

III. CONCEPTS OF WEATHER SUPPORT

1. R & D TEST (4TH WEATHER GROUP)

The 4th Weather Group is assigned the task of providing meteorological support for satellite systems during the R & D phase. The main points of contact for providing this support are the 4th Weather Group Headquarters, and the staff meteorologists at AFBMD, Los Angles, and the 6594th Test Wing (Satellite) (ARDC), Sunnyvale, Calif. The support provided by these three units are summarized below:

a. 4th Weather Group Headquarters - The Commander, 4th Weather Group, acting in his role of Staff Meteorologist to Commander ARDC, will provide Hq ARDC with advice on management of resources for providing meteorological input for satellite test operations. He will also recommend to Hq AWS plans and programs for furnishing the required meteorological support. In addition, he will keep the proposed operational command apprised of the meteorological support which he anticipates will be required in the operational use of these systems.

b. Staff Meteorologist, AFBMD. The Staff Meteorologist will attempt to identify the meteorological effects which may influence the planning and eventual operation of military satellite systems. Close coordination between the contractors, AFBMD personnel and Hq 4th Weather Group are required. The early identification of these anticipated environmental effects is the foundation for future meteorological support requirements for both R & D test and operational phases. The preparation of statements of environmental

effects is a vital portion of the entire cycle of 4th Weather Group's meteorological support.

c. Staff Meteorologist, 6594th Test Wing. Forecasts, observations and staff services for systems test and test evaluations of DISCOVERER and MIDAS have been developed. Procedures for SAMOS will undoubtedly follow in a similar fashion. The continuation of these services during R & D phases will provide:

(1) The basis for meteorological services for future satellite test systems.

(2) Experience in satellite system meteorological support.

(3) The nucleus of knowledge, personnel and an organization for providing meteorological services required in the military operational capability of supporting military satellite systems.

2. PLANNING (AWS CLIMATIC CENTER)

Climatological support to planning, test, and operation of military satellite systems can best be provided through development of an EDP tape source of Communist bloc weather data. This tape source should include 3-hourly surface data (selected elements) and 12-hourly upper air data, either actual or synoptically derived, covering a large number of evenly spaced grid points over the entire Communist area for a continuous period of at least 5 years. This type of data is not currently available and is required to permit simultaneous or lag correlations of data for difference points; development of probabilities of persistence of various meteorological parameters; and other similar summaries.

This data source is also required for development of necessary

statistical regression equations to prepare automated forecasts in support of satellite system operation.

Although expressly required in support of satellite systems, this source would further fill an existing gap in climatological data for all types of military planning. Minimum estimated lead-time on preparation of this tape deck is 1½ to 2 years. The Post Weather Analysis Division of Det 3, Hq AWS has most of the required data processing equipment to develop these data and is prepared to initiate this project when personnel and other resources are provided.

3. OPERATION (3RD WEATHER WING)

Real-time forecasts of specific weather elements are required in support of both the test and operational phases of all these satellite systems. These requirements include:

a. Relatively short-period forecasts of the elements comprising a conventional terminal forecast for the launch operation of all satellites.

b. Detailed global cloud and obscuring phenomena forecasts for the orbital phase of the SAMOS E series.

c. Specific forecasts of severe weather and other elements affecting the capsule-recovery stage of the SAMOS E-5 system and the data-readout stage of other satellite systems.

The launch and recovery forecast requirements stated above are and will be satisfied by weather data and forecasts available from established sources. The detailed cloud forecasts that will be required in support of the SAMOS system must, however, be prepared by a centralized agency routinely receiving the large volume of world-wide weather data necessary and where personnel, facilities,

and techniques are available to rapidly process these data and prepare the detailed, accurate cloud forecasts required. In addition, this forecast support must be delivered and applied to meet the user's requirement in a form directly compatible with the anticipated high degree of automation and sophistication of the programs for the control and decision-making functions relative to the operational SAMOS satellite system.

The Global Weather Control of the 3rd Weather Wing, functioning as the primary electronic-data-processing agency of the overall AWS ADPS, will be the only source of this detailed cloud forecast information. In the GWC will be available the data, the skilled people, and the rapid and accurate data processing equipment (in the form of the IBM 7090 electronic computer) required to accomplish this mission.

To develop the capability to perform this mission, it is necessary for the 3rd Weather Wing to:

a. Develop an immediate capability to prepare, on a limited scale, the cloud forecasts required to support the test phase of the SAMOS system. Direct communication support will be required to provide this information on a continuous basis to the 6594 Test Wing (Satellite).

b. Develop meteorological techniques applicable to the automation of the preparation of global cloud and obscuring phenomena forecasts.

c. Prepare the electronic computer programs and data-processing procedures to apply these meteorological techniques to the routine production of global cloud forecasts by automated methods.

4. Integrate the machine-produced forecasts into the operational control computer programs of the satellite control center.

The 3rd Weather Wing has already initiated several actions in anticipation of this mission. A manual capability to prepare cloud forecasts of a very limited scope has been developed. Cloud forecasting techniques are under development aimed at the automation of this function and the preparation of this information on the IBM 7090 electronic computer scheduled for installation in 2Q/FY61. It is expected that ultimately these forecasts will be provided in a directly-applicable format consisting of a gridded, variable time-period, global forecast chart of cloud amount and height that will be directly imputted to the satellite control computer programs and continuously up-dated.

A major deficiency encountered in the development of this cloud forecasting capability is the lack of a source of detailed cloud and other weather data, particularly over the Asian continent, to be used in the statistical and empirical approach to this problem. A comprehensive source of these data, in the form of readily-usable magnetic tape, including at least five years of 3-hourly surface observations from all available Eurasian stations is a necessity. These data are required very early in the development phase of these automated techniques.

IV SUMMARY AND RECOMMENDATIONS

The support to military satellite systems presents a number of unique, new and difficult meteorological data requirements. The support of the operational SAMOS system will almost certainly require an enormous meteorological data input involving climatological, observational and forecast data in a form precisely tailored to the decision process. There is every indication that a large volume of these data will be in automated form. These will have to be supplied from the AWS Automatic Data Processing System at Offutt. It would be hard to over-emphasize the potential value of this service to the SAMOS program.

Although the support requirements to MIDAS and the other satellite systems are not so clearly defined as those in the SAMOS program, there is a strong possibility that the operational MIDAS will present demands for global cloud data on a real-time basis. If this information is required at all, the process in which it is utilized will be of automatic or mechanical nature and hence will demand these data in form suitable for use in electronic data processing systems.

These considerations require that the following actions be taken:

1. The 3rd Weather Wing should develop meteorological techniques to provide cloud and obscuring phenomena data output in sufficient detail over the area to be reconnoitered by SAMOS and MIDAS to permit optimum use of these data in the test and development phases.

2. The Air Weather Service Climatic Center should collect and reduce to a form suitable for machine processing, all climatological data over the Eurasian area applicable to either the SAMOS or MIDAS planning or employment program. These data would also serve as a necessary base for the development of forecasting techniques.

3. Those programs which are developed by the 3rd Weather Wing to support the operation of the SAMOS or MIDAS systems should be incorporated into the support of the R & D test of these systems as soon as practicable. This will enable the test program to evaluate the operational suitability of the techniques to be used.

These actions, if timely executed, will bring the Air Weather Service support capability abreast of the development programs in the satellite systems considered in this report. Otherwise, there is a grave danger that the Air Weather Service will be incapable of meeting the meteorological requirements which are inherent in these satellite programs. This, we believe, would result in a marked degrading of effectiveness and mission accomplishment in these systems so important to national security.

If these development programs are undertaken, there is little doubt that some additional resources will have to be provided with a comparable priority to the systems they are designed to support.